Departmental Colloquia

Department of Mathematics
香港城市大學
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DEPARTMENT OF MATHEMATICS

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Discontinuous Galerkin methods for the numerical simulation of thermo-poroelastic processes

by

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ABSTRACT

Poroelasticity inspects the interaction among elastic deformations and fluid flow within a porous material. In several applications in the context of environmental sustainability, such as geothermal energy production and CO2 sequestration, temperature plays a key role in the characterization of the physical phenomena. Therefore, a fully-coupled thermo-poroelastic system of equations is needed to correctly describe these geological processes. We present and analyze a Discontinuous Galerkin method for the numerical modeling of the non-linear thermo-poroelastic problem based on a novel four-field weak formulation. The proposed method is designed to allow arbitrary-order accuracy and support general polygonal meshes. This is a key feature in geological modeling in order to handle heterogeneous layers and degenerate elements arising in the case of compaction or erosion. To handle the non-linear convective transport term in the energy conservation equation we adopt a fixed-point linearization strategy and different linearizations are examined. A complete set of numerical simulations is presented in order to validate the a priori hp-version error estimates, to inspect numerically the robustness properties, and to test the capability of the proposed method.

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